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Engineering Institute Lecture Series

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Applied Engineering Technology-1 (AET-1)
Los Alamos National Laboratory

Laser Scanning and 3-D CAD Model Generation of a 40-Year Old Particle Accelerator

Tuesday, January 8, 2013

3:30 - 4:30 PM

Los Alamos Research Park, 2nd Floor, Conference Room 203A

Abstract: The Los Alamos Neutron Science Center (LANSCE) is a research facility that was designed and constructed in the 1960's. LANSCE uses a multi-component linear particle accelerator to create a pulsed beam of hi-speed protons that strike a heavy metal target to produce neutrons for scientific research. One of the primary accelerator structures at LANSCE is the Drift Tube Linac (DTL). The DTL contains integrated water cooling systems which far exceeded their intended lifetime and required replacement. Unfortunately, limited engineering design documentation from the 1960s was available and no CAD models existed for the DTL or its subsystems. In addition, years of design modifications, configuration changes, and subsystem enhancements resulted in a complex integrated structure contained in a very cramped environment. Furthermore, facility operation schedules limited access to the DTL tunnel making timely mechanical inspections and interrogations difficult. All of these conditions and constraints produced an extremely challenging environment for an engineering refurbishment team.

In order to document the existing water cooling system hardware, identify mechanical interfaces, and understand the physical constraints of the surrounding facility and equipment, it was decided that a 3-D CAD model was needed and that modern optical scanning systems could be used to aid in the production of such a model.

This presentation will describe how a FARO Laser Scanner LS HE40 system was used to collect point cloud data of the DTL, its subsystems, and the surrounding LANSCE facility using more than 300 scans over a volume of approximately 30 by 18 by 240 feet. The Faro LS uses phase shifting and rastering of a laser beam to construct a three dimensional view of solid structures within its field of view and solid angle scan space. To obtain complete 3-D imaging of an object, multiple scans are made from different vantage points and resulting point cloud files are stitched together with the aid of reference targets placed and fixed within the scanning volume. The point cloud files are enormous in computational space and require extensive manipulation with custom software to create usable viewer files. The process of generating these viewer files and utilizing them to generate 3D Solidworks CAD models will be described. Finally, a demonstration will be given to show how these 3D viewer files and CAD models were used to design and plan for the installation of the new DTL water cooling systems.

Biography: Dr. John Bernardin holds a PhD in Mechanical Engineering from Purdue University with a specialization in heat transfer. He has been an R&D Engineer with Los Alamos National Laboratory since 1996, and is also the President and Owner of Engineering & Technology Instruction, LLC as well as an adjunct Professor with the University of New Mexico.

Dr. Bernardin is currently the Systems Engineer and Lead Mechanical Engineer for NNSA's Global Burst Detection CXD spacecraft instrument and the Project Leader for the refurbishment of the LANSCE Drift Tube Linac Water Cooling and Temperature Control Systems. Previously, Dr. Bernardin participated in the design, fabrication and testing of seven other spaceflight instruments including the NASA Mars Science Lab ChemCam Instrument (currently operating aboard the rover Curiosity), NASA Dawn GRaND instrument, NASA Interstellar Boundary Explorer, NASA Gamma Ray/Neutron Detector, NASA Mars Scout SCIM payload, DARPA XNAV X-ray telescope, and NNSA GBD BDV instrument. In addition, Dr. Bernardin has assisted in designing and fielding mechanical systems for several World-Class facilities critical to the research and defense missions of the United States. His engineering teams were responsible for the design of thermal control and vacuum systems on the Spallation Neutron Source's linear particle accelerator, the temperature control system on the LANSCE Linac, the laser conditioning optics for the National Ignition Facility, the thermal control systems for LANL's Nuclear Materials Storage Facility, and the cooling system of a solid-state vertex detector for the Relativistic Heavy Ion Collider's PHENIX Experiment. Dr. Bernardin's interests span mechanical design, numerical modeling, and experimental testing. He has authored over 65 scientific and engineering papers in the refereed literature and more than 40 other publications covering a wide range of topics including thermal and fluid sciences, optics, surface chemistry, cryogenics, vacuum science and technology, materials processing, electronic cooling, boiling and two-phase flow, environmental testing, and space-based detection techniques and technologies. A few of his selected awards include the 2012 NNSA Defense Programs Award of Excellence, 2011 U.S. D.O.E. Secretary's Achievement Award, 2007 Distinguished Alumni Award for U.W. Milwaukee, two LANL Distinguished Performance Awards, and Five LANL LAAP Awards.

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